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UTILITY PATENT APPLICATION TRANSMITTAL

Attorney Docket No.	03DV-7049
First Named Inventor or Application Identifier	Walter John Martiny, Jr.
Title	BEARING CURRENT REDUCTION ASSEMBLY
Express Mail Label No.	EL319731243US

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APPLICATION ELEMENTS <small>See MPEP chapter 600 concerning utility patent application contents.</small>		ADDRESS TO: Assistant Commissioner for Patents Box Patent Application Washington, DC 20231	
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2. <input checked="" type="checkbox"/> Specification <small>(Preferred arrangement set forth below)</small> - Descriptive title of the Invention - Cross References to Related Applications - Statement Regarding Fed sponsored R & D - Reference to Microfiche Appendix - Background of the Invention - Brief Summary of the Invention - Brief Description of the Drawings (if filed) - Detailed Description - Claim(s) - Abstract of the Disclosure	[Total Pages 7]	7. Nucleotide and/or Amino Acid Sequence Submission <small>(If applicable, all necessary)</small> a. <input type="checkbox"/> Computer Readable Copy b. <input type="checkbox"/> Paper Copy (identical to computer copy) c. <input type="checkbox"/> Statement verifying identity of above copies	
3. <input checked="" type="checkbox"/> Drawing(s) (35 USC 113)	Total Sheets 2	ACCOMPANYING APPLICATION PARTS	
4. Oath or Declaration	Total Pages 2	8. <input checked="" type="checkbox"/> Assignment Papers (cover sheet & document(s))	
a. <input checked="" type="checkbox"/> Newly executed (original or copy)		9. <input type="checkbox"/> 37 CFR 3 73(b) Statement <small>(when there is an assignee)</small>	<input checked="" type="checkbox"/> Power of Attorney
b. <input type="checkbox"/> Copy from a prior application (37 CFR 1.63(d)) <small>(for continuation/divisional with Box 17 completed)</small> <small>[Note Box 5 below]</small>		10. <input type="checkbox"/> English Translation Document (if applicable)	
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5. <input type="checkbox"/> Incorporation by Reference (useable if Box 4b is checked) The entire disclosure of the prior application, from which a copy of the oath or declaration is supplied under Box 4b, is considered as being part of the disclosure of the accompanying application and is hereby incorporated by reference therein.		12. <input type="checkbox"/> Preliminary Amendment	
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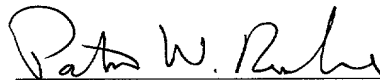
Express Mail mailing label number: **EL319731243US**

Date of Mailing: **July 13, 2000**

I certify that the attached patent application of **WALTER JOHN MARTINY, JR.**
for a **BEARING CURRENT REDUCTION ASSEMBLY**, including:

- Certificate of Mailing Via Express Mail (1 page)
- Utility Patent Application Transmittal (1 page)
- Fee Transmittal (in duplicate) (1 page)
- Declaration and Power of Attorney (2 pages)
- Assignment (1 page)
- Assignment Recordation Cover sheet (in duplicate) 1 page)
- Four (4) pages of specification; two (2) pages of claims; one (1) page of abstract
- Two (2) sheets of drawings
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BEARING CURRENT REDUCTION ASSEMBLY

BACKGROUND OF THE INVENTION

This invention relates generally to electric motors and, more particularly, to bearing assemblies for electric motors with adjustable speed drives.

A/C electric motors typically include a motor housing, a stator including one or more stator windings, and a rotor assembly. The rotor assembly includes a rotor core and a rotor shaft extending through the rotor core. The motor housing includes at least one endshield and houses at least a portion of the rotor assembly. Electric motors also typically include at least one bearing sized to receive and support the rotor shaft, and at least one inner bearing cap separated from the bearing. Typically, the bearing is positioned between an endshield and an inner bearing cap and facilitates rotation of the rotor shaft when the stator windings are energized. An adjustable speed drive circuit is coupled to an inverter and the motor to selectively vary the motor speed as desired in a particular application.

Improvements in inverter technology have led to increased use of adjustable speed drives with A/C induction motors. High speed switching of power supplied to these motors often results in charge build up between the rotor and the stator until a sparking voltage develops across the bearing. Once a sparking voltage develops, a spark discharges across the bearing. After the initial spark, a capacitive coupling between the rotor and stator provide a damaging "follow on" current through the bearing. This current damages the bearing thus affecting motor reliability and performance. Insulated bearings, shaft brushes, and modified drive circuits have been employed to reduce and/or eliminate damaging current flow through the bearings, but tend to increase the cost of the motor, reduce motor performance, or introduce costly maintenance issues.

Accordingly, it would be desirable to provide a low cost bearing assembly that reduces or eliminates current flow through the bearings to improve motor reliability and performance while avoiding costly maintenance issues.

BRIEF SUMMARY OF THE INVENTION

In an exemplary embodiment of the invention, a bearing current reduction assembly includes a rotor shaft, an inner bearing cap having an inner end,

and a charge concentrator disposed on either the rotor shaft or the inner end, or both. The inner bearing cap is substantially radially aligned with the rotor shaft. The inner end is in close proximity to the rotor shaft and separated from the rotor shaft by a clearance.

5 The charge concentrator concentrates electrical charge to produce a higher electrical field concentration through the clearance than occurs within a bearing. Accordingly, during operation of an induction motor with an adjustable speed drive, charge build up between the rotor shaft and a stator discharges at the charge concentrator instead of within a bearing. More specifically, rotor to stator
10 currents through the bearings are reduced or eliminated.

Accordingly, the bearing current reduction assembly provides a low cost bearing assembly that reduces or eliminates current flow through the bearings to improve motor reliability and performance while avoiding costly maintenance issues.

BRIEF DESCRIPTION OF THE DRAWINGS

15 Figure 1 is a cross-sectional view of a motor assembly including a bearing current reduction assembly;

 Figure 2 is a schematic view of the bearing current reduction assembly shown in Figure 1; and

 Figure 3 is a schematic view of a second embodiment of a bearing current reduction assembly.

DETAILED DESCRIPTION OF THE INVENTION

20 Figure 1 is a cross-sectional view of a motor assembly 10 including a motor housing 12, a stator 14 having a plurality of windings, a rotor assembly 16 and a bearing current reduction assembly 18. Rotor assembly 16 includes a rotor shaft 20 mounted on a rotor core 22. A bearing 24 is positioned between an endshield 26 and an inner bearing cap 28.

25 Energizing the stator windings with alternating current produces a changing magnetic field or flux within rotor core 22 causing rotor shaft 20 to rotate. The angular velocity of rotor shaft 20 is partially a function of the power delivered to motor assembly 10. Typically, an adjustable speed drive circuit (not shown) is

coupled to an inverter (not shown) and motor assembly 10 to vary an angular velocity of rotor shaft 20. High speed switching of power supplied to motor assembly 10 often produces a charge build up between rotor shaft 20 and stator 14.

Bearing current reduction assembly 18 provides an electrical path from rotor shaft 20 to stator 14 that does not include bearing 24. Accordingly, damaging rotor to stator currents through bearing 24 are reduced or eliminated. Although, an exemplary embodiment is described in the context of a motor having an adjustable speed drive, it is contemplated that the benefits of the invention accrue to a wide variety of motors for various applications and controlled by alternative drive circuits.

Figure 2 is a schematic view of bearing current reduction assembly 18 (shown in Figure 1) including an inner bearing cap 28 substantially radially aligned with rotor shaft 20 and having an outer end 30 and an inner end 32. Inner end 32 includes bearing cap charge concentrator 34 in close proximity with rotor shaft 20 and separated from rotor shaft 20 by a clearance 36. In an exemplary embodiment, clearance 36 is approximately 0.005 inch to provide adequate shaft clearance while facilitating current flow from rotor shaft 20 to stator 14. In an alternative embodiment, clearance 36 is greater or lesser than 0.005 inch. Bearing 24 is positioned between inner bearing cap 28 and endshield 26.

During operation, a charge build up between rotor shaft 20 and stator 14 (as shown in Figure 1) concentrates at bearing cap charge concentrator 34 providing a higher electrical field concentration through clearance 36 than an electrical field concentration through bearing 24. Accordingly, charge build up bleeds off or discharges, flowing through clearance 36 instead of through bearing 24. Thus, damaging current flow through bearing 24 is reduced or eliminated.

In an exemplary embodiment, inner end 32 is machined to provide a sharp edge 38 facing rotor shaft 20 such that sharp edge 38 has a small radius to concentrate charge. Inner bearing cap 28 is fabricated from a suitable electrically conducting material. In an exemplary embodiment, inner bearing cap 28 is made of aluminum alloy 850.00.

Figure 3 is a schematic of another exemplary embodiment of a bearing current reduction assembly 40, similar to bearing current reduction assembly 18, including an inner bearing cap 28 having an outer end 30 and an inner end 32. Rotor shaft 20 includes a rotor charge concentrator 42 in close proximity to bearing cap 28

and separated from bearing cap 28 by a clearance 46. In an exemplary embodiment, clearance 46 is approximately 0.005 inch to provide adequate shaft clearance while facilitating current flow from rotor shaft 20 to stator 14. In an alternative embodiment, the clearance between rotor charge concentrator 42 and inner end 32 is greater or lesser than 0.005 inch. Bearing 24 is positioned between inner bearing cap 28 and endshield 26. In one embodiment, rotor shaft 20 is machined with a sharp edge 44 thereon to provide a rotor charge concentrator 42 with a small radius such that the sharp edge 44 concentrates charge.

During operation, a charge build up between rotor shaft 20 and stator 14 (as shown in Figure 1) concentrates at rotor charge concentrator 42 generating a higher electrical field concentration through clearance 46 than through bearing 24. Accordingly, charge build up bleeds off or discharges, flowing through clearance 46 instead of through bearing 24. Thus, damaging current flow through bearing 24 is reduced or eliminated.

While the invention has been described in terms of various specific embodiments, those skilled in the art will recognize that the invention can be practiced with modification within the spirit and scope of the claims.

WHAT IS CLAIMED IS:

1. A bearing current reduction assembly comprising:

a rotor shaft;

an inner bearing cap substantially radially aligned with said rotor shaft,
said inner bearing cap comprising an inner end, said inner end in close proximity to
said rotor shaft; and

a charge concentrator disposed on at least one of said rotor shaft and
said inner end.

2. An assembly according to Claim 1 wherein said charge
concentrator includes an edge having a small radius to concentrate electrical charge
thereon.

3. An assembly according to Claim 1 wherein said inner end is
within approximately 0.005 inch from said rotor shaft.

4. An assembly according to Claim 1 wherein said inner bearing
cap comprises an aluminum alloy.

5. An assembly according to Claim 1 wherein said rotor shaft
comprises said charge concentrator.

6. An assembly according to Claim 1 wherein said inner end
comprises said charge concentrator.

7. An electric motor assembly comprising:

a motor housing;

a stator mounted in said housing and comprising a bore therethrough;

a rotor core rotatably mounted in said housing and extending through
said stator bore;

a rotor shaft extending through said rotor core;

at least one endshield;

an inner bearing cap radially aligned with said rotor shaft, said inner bearing cap having an inner end and an outer end, said inner end in close proximity to said rotor shaft; and

5 a charge concentrator disposed on at least one of said rotor shaft and said inner end.

8. An electric motor assembly according to Claim 7 wherein said charge concentrator includes an edge having a small radius to concentrate electrical charge thereon.

10 9. An electric motor assembly according to Claim 7 wherein said inner end is within approximately 0.005 inch from said rotor shaft.

10. An electric motor assembly according to Claim 7 wherein said inner bearing cap comprises an aluminum alloy.

11. An electric motor assembly according to Claim 7 wherein said rotor shaft comprises said charge concentrator.

15 12. An electric motor assembly according to Claim 7 wherein said inner end comprises said charge concentrator.

13. A bearing assembly for a rotor shaft comprising:

a bearing for supporting the shaft; and

20 an inner end cap separated from said bearing and configured to receive an electrical current from the rotor shaft.

14. A bearing assembly according to Claim 13 wherein the rotor shaft comprises at least one charge concentrator.

15. A bearing assembly according to Claim 13 wherein said inner cap comprises at least one charge concentrator.

A BEARING CURRENT REDUCTION ASSEMBLY AND METHOD

ABSTRACT OF THE DISCLOSURE

- 5 An electric motor with an adjustable speed drive includes a bearing current reduction assembly including a charge concentrator providing a higher electric field concentration through a clearance between an inner bearing cap and a rotor shaft than occurs within a bearing. Accordingly, damaging rotor to ground currents through a bearing are reduced or eliminated. The charge concentrator is disposed on either the rotor shaft or the inner bearing cap, or both.

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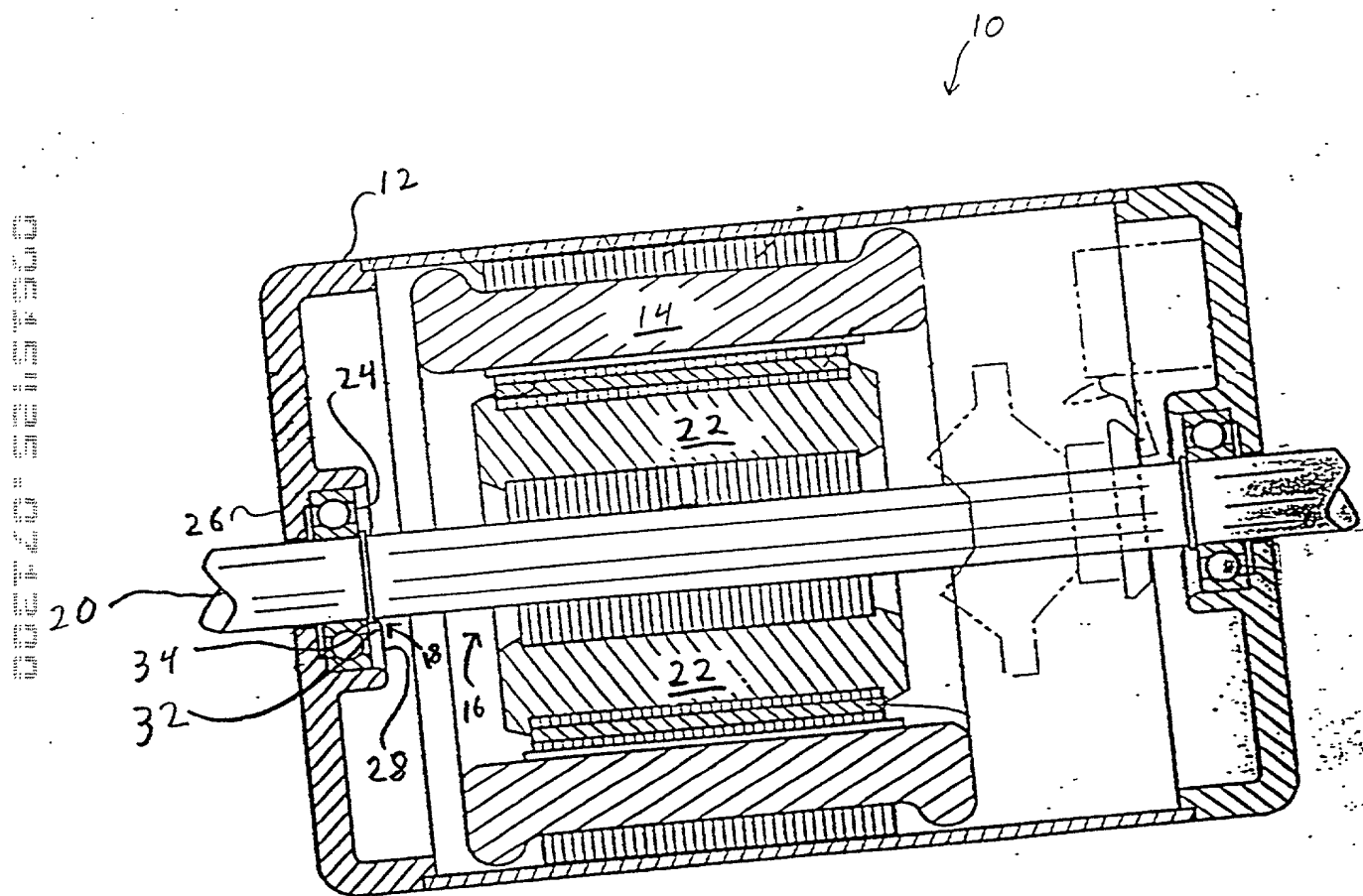
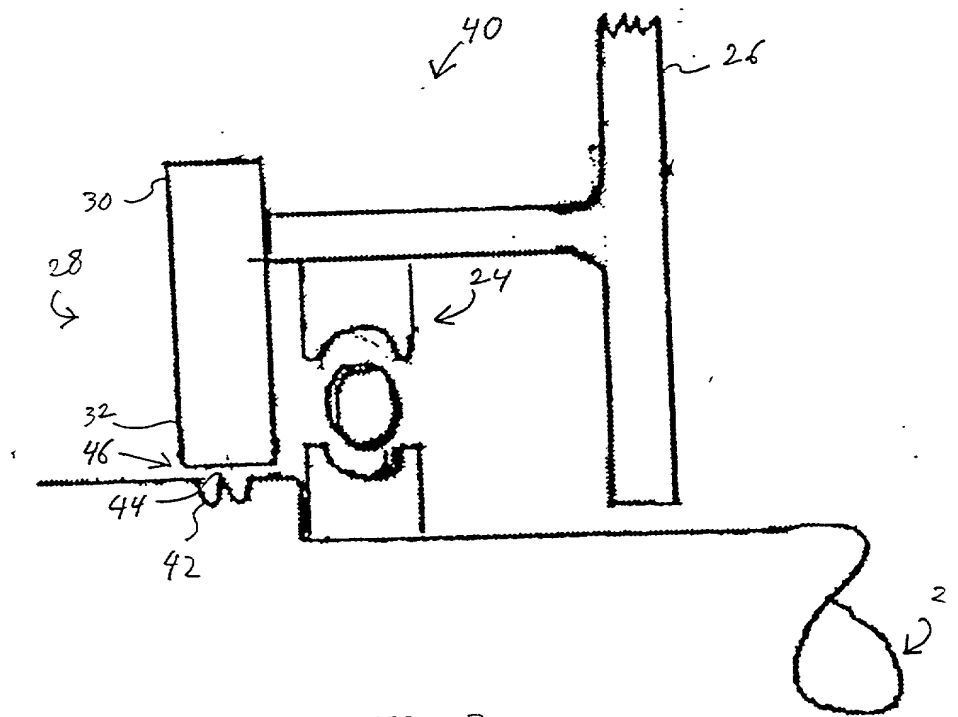
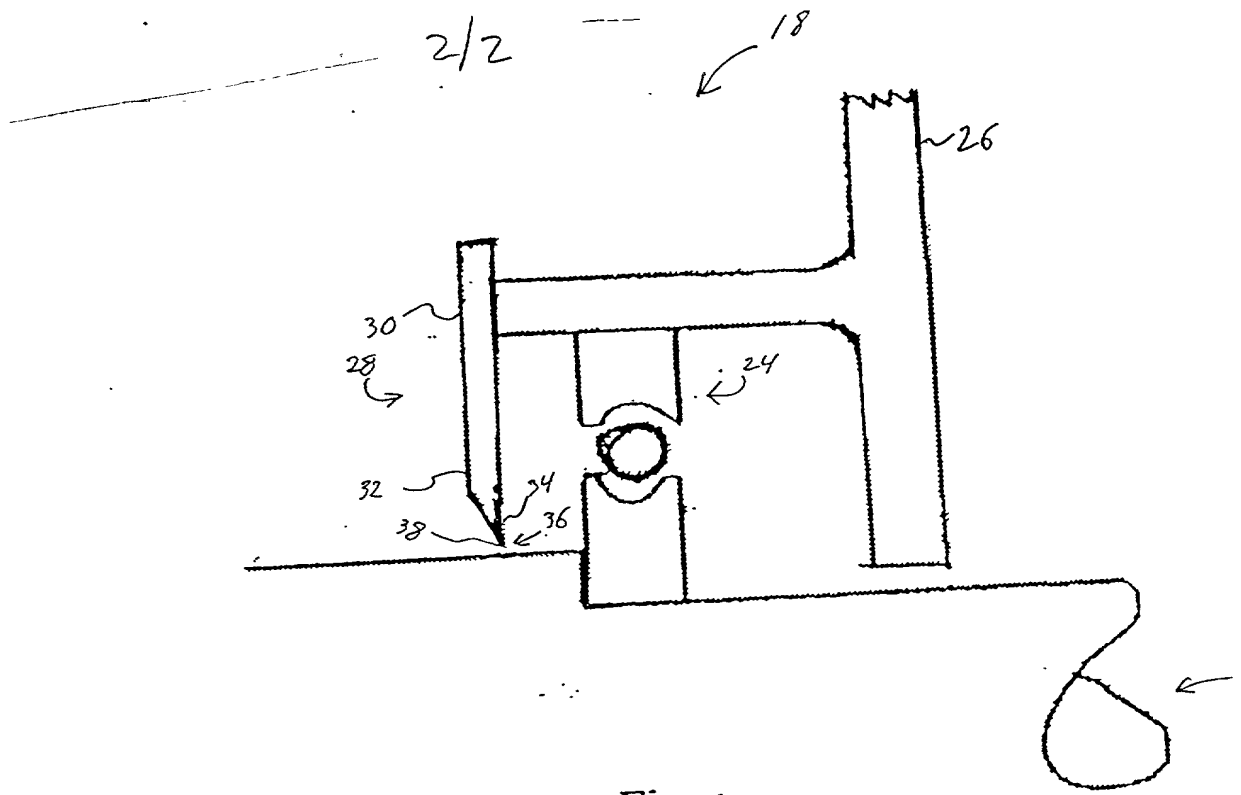


FIG. 1



COMBINED DECLARATION AND POWER OF ATTORNEY	Attorney Docket No. 03DV-7049
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As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below next to my name.

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled: **BEARING CURRENT REDUCTION ASSEMBLY, (Docket No. 03DV-7049)**, the specification of which:

(check one) ☒ is attached hereto
 ☐ was filed on _____ as Application Serial No. _____,
 and was amended on _____.

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose information which is material to the examination of this application in accordance with Title 37, Code of Federal Regulations §1.56(a).

I hereby claim priority benefits under Title 35, United States Code, §120 of any United States application(s) listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States application in the manner provided by the first paragraph of Title 35, United States Code, §112. I acknowledge the duty to disclose material information as defined in Title 37, Code of Federal Regulations, §1.56(a) which occurred between the filing date of the prior application and the national or PCT international filing date of this application:

Application Serial No.	Filing Date	Status (patented, pending, abandoned)
_____	_____	_____
_____	_____	_____
_____	_____	_____

I hereby claim the benefit under Title 35, United States Code §119(e) of any United States provisional application(s) listed below:

Application Serial No.	Filing Date	Additional provisional application numbers are listed on a supplemental priority sheet attached hereto.
_____	_____	_____
_____	_____	_____
_____	_____	_____

I hereby appoint Ronald E. Myrick, Reg. No. 26,315; Henry J. Policinski, Reg. No. 26,621; Jay L. Chaskin, Reg. No. 24,030; Henry I. Steckler, Reg. No. 24,139; and James W. Mitchell, Reg. No. 25602, all of General Electric Company, 3135 Easton Turnpike, Fairfield, CT 06431; Carl B. Horton, Reg. No. 34,622; Damian G. Wasserbauer, Reg. No. 34,749; Wayne O. Traynham, Reg. No. 29,872; and Dave S. Christensen, Reg. No. 40,955, all of General Electric Company, 41 Woodford Avenue, Plainville, CT 06062; and John S. Beulick, Reg. No. 33,338 and Patrick W. Rasche, Reg. No. 37,916, all of Armstrong Teasdale LLP, One Metropolitan Square, Suite 2600, St. Louis, MO 63102, jointly, and each of them severally, my attorneys and attorney, with full power of substitution, delegation and revocation, to prosecute this application, to make alterations and amendments therein, to receive the patent and to transact all business in the Patent and Trademark Office connected therewith.

I hereby direct that all correspondence and telephone calls in connection with this application be addressed to the said

John S. Beulick, Reg. No. 33,338
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 St. Louis, MO 63102.
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COMBINED DECLARATION AND POWER OF ATTORNEY	Attorney Docket No. 03DV-7049
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I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application and any patent issued thereon.

SOLE OR FIRST INVENTOR:

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Signature: Walter John Martiny Jr. Date: July 12, 2000

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Signature: _____ Date: _____

Residence: _____

Citizenship: _____

Post Office Address: _____

THIRD JOINT INVENTOR, IF ANY:

Full Name: _____

Signature: _____ Date: _____

Residence: _____

Citizenship: _____

Post Office Address: _____

FOURTH JOINT INVENTOR, IF ANY:

Full Name: _____

Signature: _____ Date: _____

Residence: _____

Citizenship: _____

Post Office Address: _____

FIFTH JOINT INVENTOR, IF ANY:

Full Name: _____

Signature: _____ Date: _____

Residence: _____

Citizenship: _____

Post Office Address: _____